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(54) Pivotable sailing boat keel

(57) A sailing boat 10 the ballast keel 12 of which is divided on at least one athwartship plane into sections 13, 15 each of which can be independently pivoted abeam in either direction and orientated to counteract heel, reduce draft, induce planing and facilitate grounding. The sections 13, 15 are mounted on a common spindle 14 and are pivotable by hydraulic rams 24, the pressure in which being relieved by mechanical abutments 38, 40. In a further embodiment a fixed keel portion has supplementary ballast keel portions individually pivoted abeam by hydraulic rams (Figs 7 and 9).

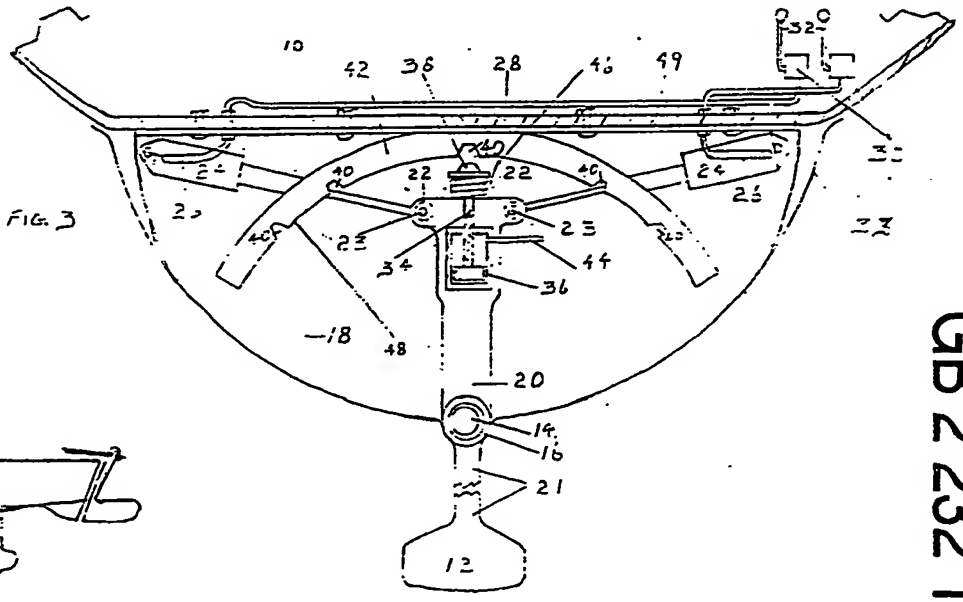
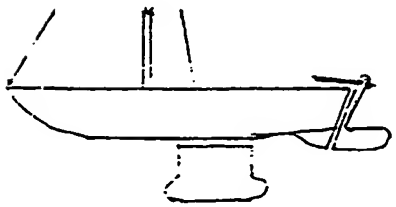


FIG. 3

FIG 1.



The specification as filed contained no reference to Figures 10 and 11.

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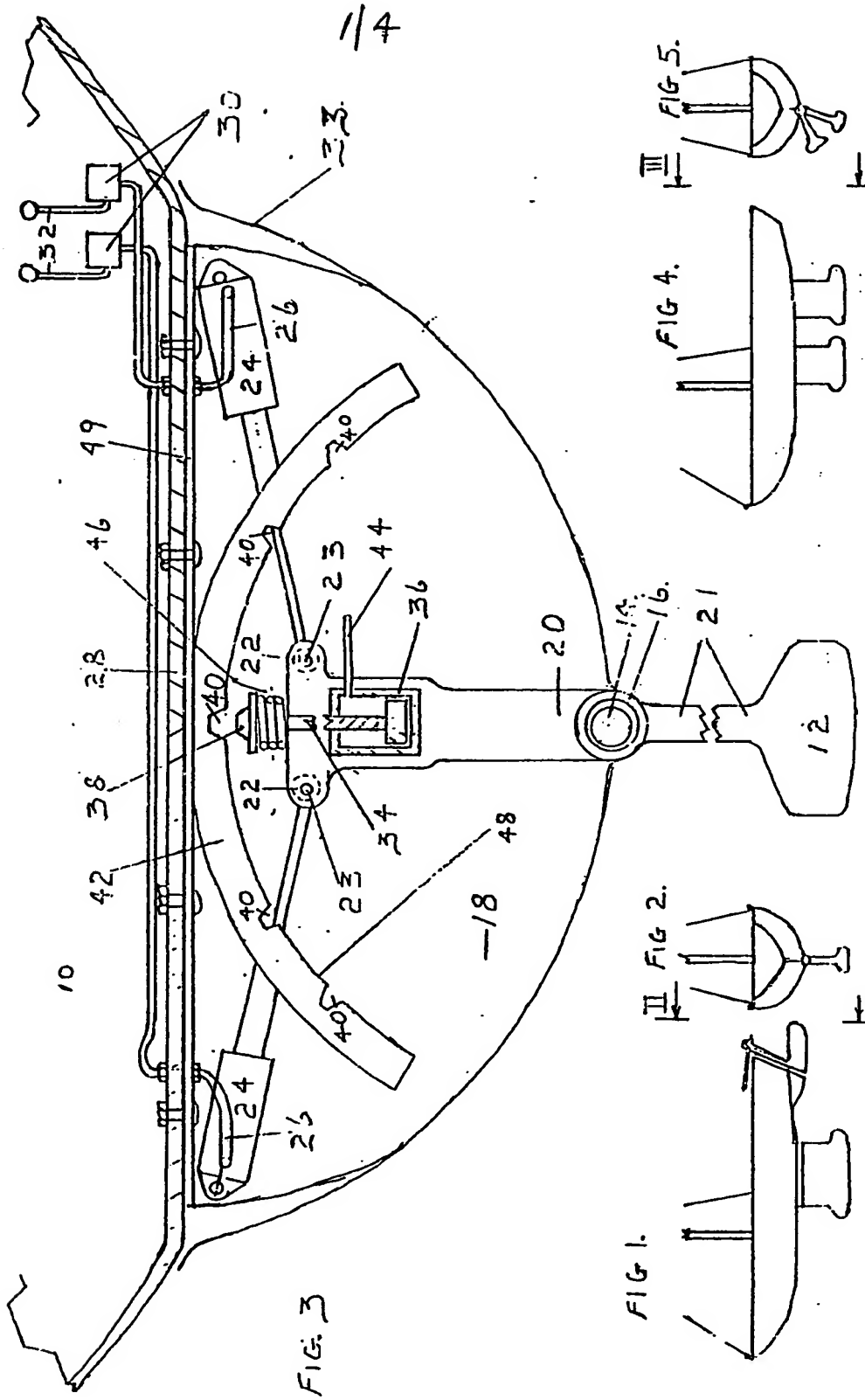


FIG. 3

FIG 5.

FIG 4.

FIG 2.

FIG 1.

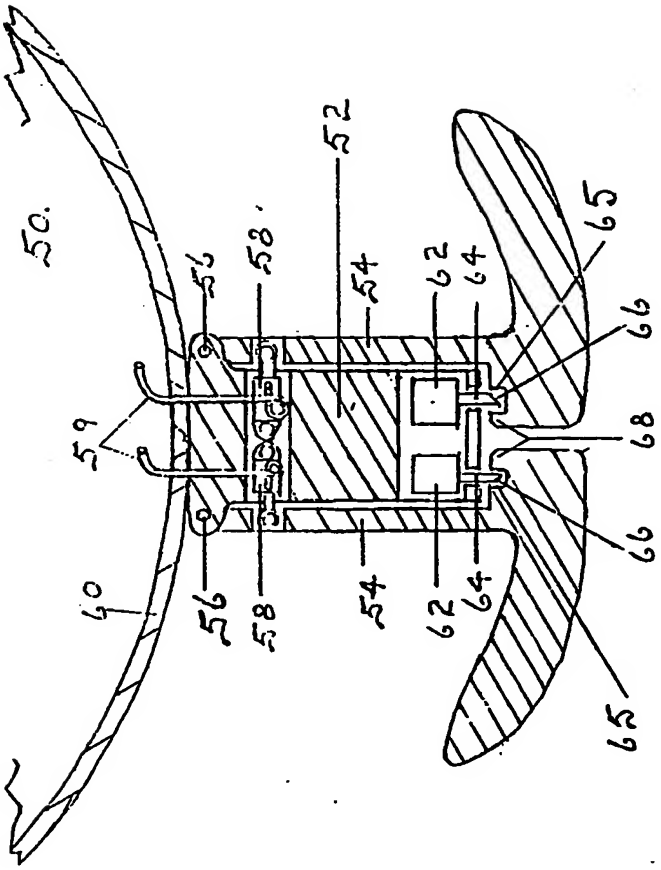


FIG 9.

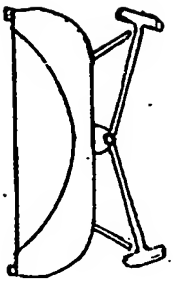


FIG 8.

FIG 7.

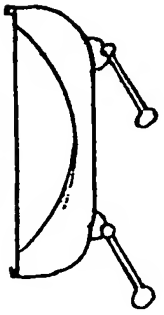
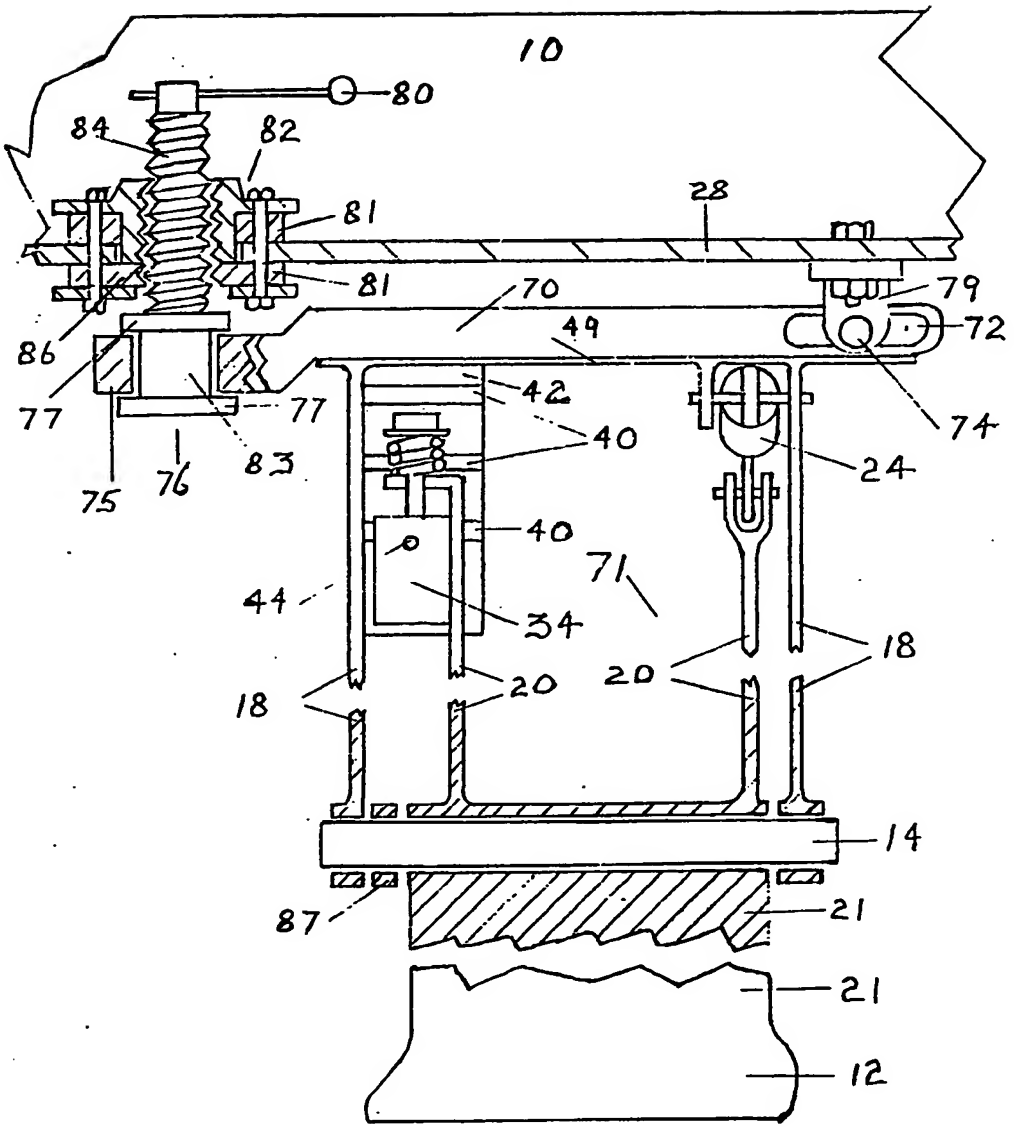


FIG 6.

FIG 10.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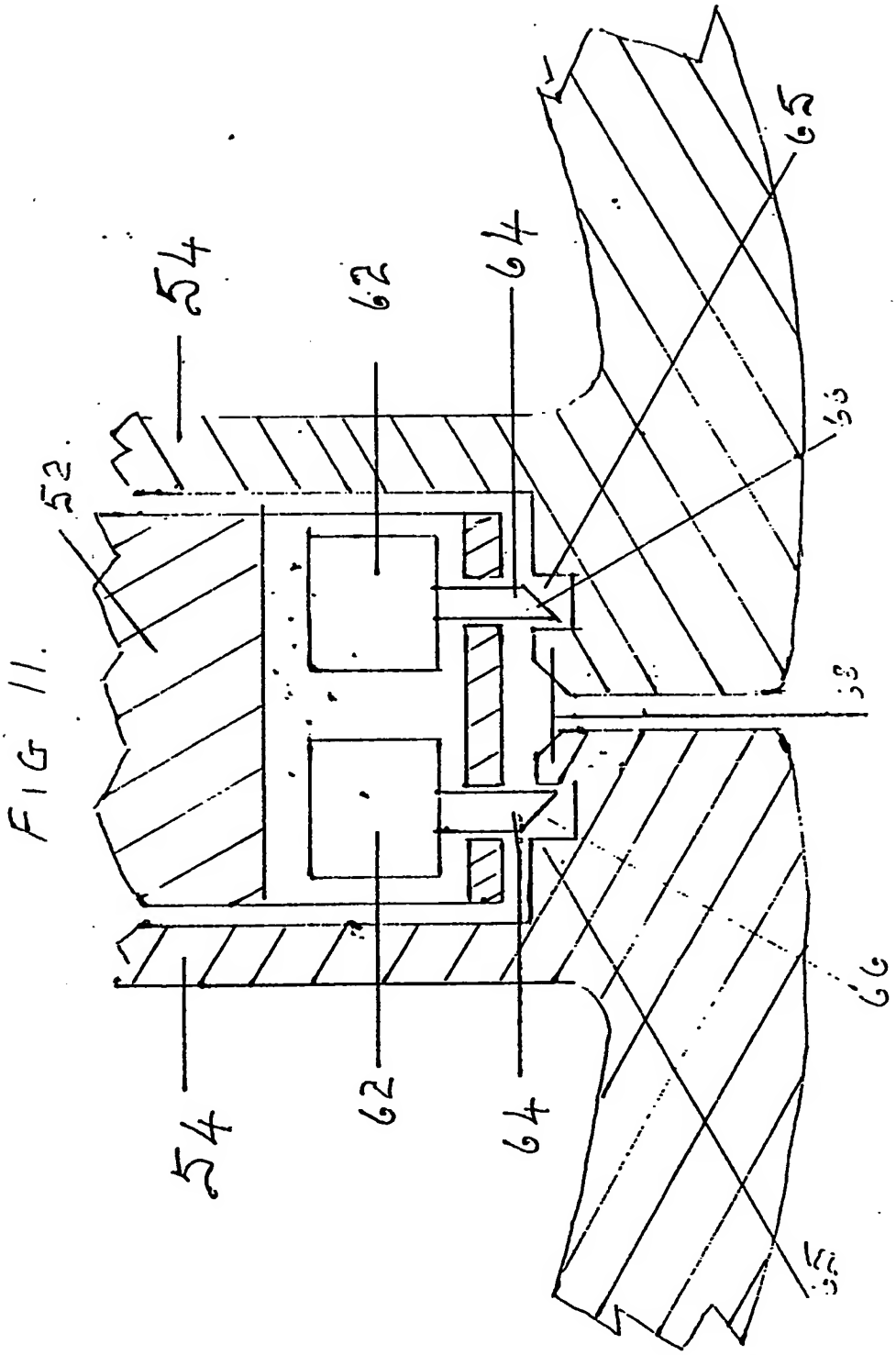

FIG 11.

PIVOTABLE SAILING BOAT KEEL

It is well known in the art of sailing that when sailing a boat in almost every direction relative to the wind, that the wind on the rigged sails exerts a turning moment on the boat about a fore-and-aft axis of bouyancy resulting in heeling, and thereby presenting the sails (especially on a fore-and-aft rigged yacht) at a skyward obtuse angle to the horizontal direction of the wind.

For maximum forward speed of the boat the mast should remain substantially upright, and this can be achieved in a small boat by transferring the weight of the crew to the windward side of the boat above water level, acting as off-centre ballast.

The mast remaining substantially upright on a catamraran contributes to it's superior speed and crew comfort, and it is the object of the present invention to endow a monohull boat with said characteristics but without inhibiting its self-righting properties after capsizing, by providing a keel the divisions of which can be pivoted abeam to transversely move the centre of gravity of the effective ballast abeam the centre line of the boat in substitution and supplementation of said crew dispostion, acknowledging that a symmetrically balanced ballast on the centre-line and below water level provides negligible reactive moment until the boat is already heeled, whereas the turning moment effect of the wind on vertical sails is at its maximum, making it almost impossible for the boat to sail at speed without heeling.

Greatest advantage in embodiment of the invention is gained when the centre of gravity of a keel is furthest from the pivot point and below water level, e.g. in a bulb and plate type keel.

Typical embodiments of the invention will now be described by reference to the accompanying drawings which may not necessarily be to or of the same scale and may be shown for clarity with exaggerated clearances between components and in which:-

Fig 1 is an abeam view of a sailing boat on an even keel and having a stayed mast (shown truncated) and a bulb and plate type ballast keel divided on an athwartships plane.

Fig 2 is an end view (with rudder removed) from line II-II of Figure 1 showing the keel with divisions in the central position, and is for identification of location of Figure 3.

Fig 3 is an enlarged part sectional view of Figure on IV-IV showing a more detailed schematic view of an embodiment of the invention of at least two units of keel divisions in line.

Fig 4 is a schematic view from line II-II of Figure 1 showing divisions of the keel biased to different angles.

Fig 5 is also a schematic view from line II-II of Figure 1 showing divisions of the keel biased to different angles.

Fig 6 is a schematic stern view of keel divisions orientated for running before the wind and for grounding.

Fig 7 is a fore-and-aft fragmented sectional view of an embodiment with a fixed centre-keel portion with supplementary abeam pivoting finned ballast portions.

Fig 8 is a schematic fragmented partly sectioned abeam view of one division of the said embodiment of Figure 3 with alternative attachment incorporating means of varying vertically the substantially horizontal spindle carrying at least two pivoting divisions and with any nacelles removed.

Fig 9 is an enlarged fragmented view of the locking device of the embodiment of Figure 7.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 3, a sailing boat 10 has a keel 12 divided on at athwartships plane into sections 13, 15, assembled in rotating engagement with spindle 14 located in housings 16 which are respectively integral with pairs of brackets 18 which in turn are integral with plate 49 attached underfoot and symmetrically on the centre-line of the hull.

At least two arms 20 are extended generally diametrically on the vertical centre-line of the fin sections 21 to receive pivot-pins 23 for connection to the plunger-end eyes 22 of at least two pairs of hydraulic rams 24 of at least one stage and pivotally attached to brackets 18.

Flexible hydraulic feed-pipes 26 connect rams 24 sealingly through the skin 28 inboard to hydraulic pumps-cum-reservoirs 30 for mechanical e.g. electric motor (not illustrated) or manual operation of reciprocating levers 32.

Pumps 30 have pressure-release devices already taught.

By operating the appropriate lever hydraulic fluid is injected into hydraulic rams 24 and the keel sections 13, 15 are pivoted abeam.

In an alternative embodiment the keel sections 13, 15 can similarly be biased by sealingly isolated mechanical means inboard, e.g. by screw jacks.

In Figure 3 a pump 30 for each ram 24 is connected directly by pipe, but one pump 30 and a selector valve connected by separate pipe to each ram 24 can equally be used.

Suitable corrosion-resistant materials would be chosen for manufacture of exposed components. Nacelles 33 could be provided, but it is not intended that operating mechanisms should be isolated from the floating medium of the boat, e.g. salt water, but they could be.

In a further embodiment the operating mechanism is inboard of the hull and below or above the water line, with adequately sealed partitioning e.g. ducting reaching above water level.

Referring to Figure 3, in order to relieve sustained hydraulic pressure during long periods of operation of the rams 24, pipes 26 and pumps 30, and thereby minimise possible fluid loss, locking devices 34 are used to hold the biased keel sections 13, 15 in pre-determined (e.g. the raised) positions by mechanical abutment with return-spring 46 for automatic engagement and disengagement by hydraulic or gas rams 36.

Figure 3 shows a typical embodiment in which hydraulic rams 36 are fixed to said extension arms 20 withdrawing the bolts 38 from one of mating recesses 40 in quadrants 42 generated on the same centre as spindle 14 and rigid with said brackets 18, when energised by pressure from an inboard pressure source (not shown) into flexible pipes 44.

On releasing said pressure in rams 36, bolts 38 slidingly abut radii 48 of quadrants 42 and engage an appropriate mating recess 40 in traversing it thereby arresting the appropriate keel division.

Referring to Fig 6, for the grounding orientation bilge fins 90 are added to act as abutments for the pivotting divisions 13, 15, said fins 90 providing also the advantage of resistance to leeway when sailing on-the-wind with keel divisions 13, 15 well raised to windward.

To induce the boat to plane with keels orientated as shown in Figure 6 while running before the wind, the forward end of at least one keel-spindle 14 is raised (or the after-end lowered) from the horizontal so that the sections act as lifting hydrofoils under speed.

Figure 8 shows that this is achieved by a preferred embodiment for varying the height of the forward end of a whole assembly 71 of a similar embodiment to that of Figure 3.

Assembly 71 is mounted underfoot of the hull 10 pivotally at one end and vertically adjustable at the other.

The plate 49 is shown re-inforced by beam 70 for rigidity, and locking devices 34 are shown mounted on separate arms 20.

Still referring to Figure 8, assembly 71 is mounted at one end by slots 72 on a spindle 74 held by brackets 79 attached to skin 28 while the other end 75 is arrested on at least one screw-jack 76 sealingly penetrating the skin 28 and rotatable by e.g. a reversible-ratchet lever 80 by the boat's crew at will and from inboard.

In this embodiment the assembly 82 forming the nut (i.e. female thread) of the screw-jack 76 is flexibly mounted on rubbers 81 to accommodate the small relative angular variation of the screw 84 and to form the said sealing of screw 84.

Beam-end 75 is retained axially by flanges 77.

Dowelled collar 87 retains spindle 14.

An alternative to the flexible mounting of assembly 82 is a part-spherical shaft 83 not illustrated but shown as a parallel journal in bore of housing at 75.

In an alternative embodiment to induce planing, to the embodiment of Figure 3 is provided a vertically-sliding version of forward-housing 16 on brackets 18, the raising and lowering of said housing being actuated by at least one hydraulic ram operated from inboard.

The small relative angular variation of spindle 14 is accommodated by rubber bushes or part-spherical bearings in housings 16.

In this embodiment, the quadrants 42 together with the locking devices 34 would need to be adjacent to the distant housing 16 from the said sliding spindle-housing to substantially maintain the relationship between locking devices 34 and quadrants 42.

In the embodiment of Figures 7 and 9 a sailing boat 50 with a fixed portion of keel 52 has supplementary ballast keel-portions 54 hingedly on pivots 56.

Portions 54 are individually pivoted abeam by hydraulic pressure in the appropriate hydraulic pivotally mounted rams 58 energised by ancillary pumps (not shown) through flexible pipes 59 led sealingly through keel 52 and skin 60.

So that neither of the portions 54 part from fixed portion 52 by gravity when the boat is heeled, a hydraulically-opening and spring-closing lock 62m, housed in keel portion 52 and similar in operation to said lock 34 of Figure 3 is provided for each portion 54.

In this embodiment however, the spring-loaded lock-plungers 64 engage in mating recesses 65. Lock-plungers 64 and keel portions 54 each have mating chamfers 66 and 68 respectively.

Portions 54 can have, as may be said other embodiments, bulb portions with exaggerated fin-like cross sections to alleviate leeway when sailing on the wind.

Thus I have disclosed a sailing boat with a divided keel which can be orientated with one or both divisions to windward thereby maintaining the sails upright when sailing on the wind for greater speed and crew comfort, and can be orientated for running, shallow water navigation, grounding and road trailing without the keel intruding into the cabin.

CLAIMS

1. A sailing boat 10 being a keel 12, the keel 12 being divided on at least one athwartships plane to form at least two keel divisions 13, 15, the divisions being pivotable one independently of another about a fore-and-aft axis.

2. A sailing boat 10 according to claim 1 in which the keel divisions 13, 15 are mounted on a common spindle 14 and are pivotable in either angular direction about a mid-keel position.

3. A sailing boat according to claims 1 and 2 characterised in that the pivoting mechanism is energised by the employment of pressurised hydraulic means, 24, 26, 32.

4. A sailing boat according to claims 1 to 3 characterised in that keel divisions 13, 15 can be arrested by mechanical abutment 38, 40 to relieve hydraulic pressure in rams 24, pipes 26 and pumps 30 during sustained long periods of operation.

5. A sailing boat according to claims 1 to 4 characterised in that each raised keel division can be instantly lowered by gravity and arrested in one of several pre-determined catchments 40.

6. A sailing boat according to claims 1 to 5 characterised in that, when the keel 12 retracts to reduce draft, it occupies no space inboard.

7. A sailing boat according to claims 1 to 6, characterised by bilge fins 90 positioned to abut the keel divisions 13, 15 when orientated for grounding.

8. A sailing boat according to claims 1 to 7 characterised in that, when grounded, a large majority of structural stress and strain via the keel divisions 13, 15 are eliminated from the pivoting mechanism.

9. A sailing boat in accordance with claim 1 characterised by means of varying the level of the spindle 14 hinging the keel 12.

10. A sailing boat 50 characterised by a fixed portion of keel 52 with hinged supplementary pivotable-abeam keel-portions 54, biasing hydraulic rams 58 and controlling locks 62.

11. A sailing boat 10 constructed and arranged substantially as hereinbefore described with reference to the Figs 1, 2, 4, 5, 6, or with reference to Fig.3 or with reference to Figs. 7 and 9 or with reference to Fig.8 of the accompanying drawings.

12. A keel 12 for use in a sailing boat 10 as claimed in any of claims 1 - 11.

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